



2004 Space Almanac

ON the following pages appears a variety of information and statistical material about space—particularly military activity in space. This almanac was compiled by *Air Force Magazine*, with assistance and information from Steve Garber, NASA History Office; Phillip S. Clark, Molniya Space Consultancy; Joseph J. Burger, Space Analysis and Research, Inc.; and US Strategic Command and Air Force Space Command Public Affairs Offices.

Figures that appear in this section will not always agree because of different cutoff dates, rounding, or different methods of reporting. The information is intended to illustrate trends in space activity.



By Tamar A. Mehuron, Associate Editor

Introduction



What's Up There

As of May 31, 2004

Country/Organization	Satellites	Space Probes	Debris	Total
CIS (Russia/former USSR)	1,349	35	2,618	4,002
US	903	52	2,872	3,827
European Space Agency	35	4	301	340
People's Republic of China	40	0	285	325
Japan	84	7	51	142
India	27	0	104	131
Intl. Telecom Sat. Org.	60	0	0	60
Globalstar	52	0	0	52
France	33	0	16	49
Orbcomm	35	0	0	35
European Telecom Sat. Org.	26	0	0	26
Germany	20	2	1	23
United Kingdom	22	0	1	23
Canada	21	0	1	22
Italy	10	0	3	13
Luxembourg	13	0	0	13
Australia	9	0	2	11
Sea Launch	1	0	10	11
Brazil	10	0	0	10
Sweden	10	0	0	10
Indonesia	9	0	0	9
Intl. Maritime Sat. Org.	9	0	0	9
NATO	8	0	0	8
South Korea	8	0	0	8
Arab Sat. Comm. Org.	7	0	0	7
Argentina	7	0	0	7
Mexico	6	0	0	6
Spain	6	0	0	6
Czech Republic	5	0	0	5
Israel	5	0	0	5
Netherlands	5	0	0	5
Turkey	5	0	0	5
AsiaSat Corp.	4	0	0	4
Intl. Space Station	1	3	0	4
Thailand	4	0	0	4
Denmark	3	0	0	3
Malaysia	3	0	0	3
Norway	3	0	0	3
Saudi Arabia	3	0	0	3
China/Brazil	2	0	0	2
Egypt	2	0	0	2
France/Germany	2	0	0	2
Philippines	2	0	0	2
UAE	2	0	0	2
Algeria	1	0	0	1
Chile	1	0	0	1
EUME	1	0	0	1
Greece	1	0	0	1
NICO	1	0	0	1
Nigeria	1	0	0	1
Pakistan	1	0	0	1
Portugal	1	0	0	1
PRES (China/ESA)	1	0	0	1
Republic of China (Taiwan)	1	0	0	1
Saudi Arabia/France	1	0	0	1
Singapore/Taiwan	1	0	0	1
US/Brazil	1	0	0	1
Total	2,884	103	6,265	9,252

Worldwide Orbital Launch Sites, 1957-2003

Launch Site	Owner	Total Launches
Plesetsk	Russia	1,542
Tyuratam/Baikonur, Kazakhstan	Russia	1,204
Vandenberg AFB, Calif.	US	626
Cape Canaveral AFS, Fla.	US	599
Kourou, French Guiana	ESA	170
JFK Space Center, Fla.	US	134
Kapustin Yar	Russia	101
Tanegashima	Japan	37
Xichang	China	36
Shuang Cheng-tsu/Jiuquan	China	32
Kagoshima	Japan	31
Wallops Flight Facility, Va.	US	30
Edwards AFB, Calif.	US	20
Sriharikota	India	18
Taiyuan	China	18
Pacific Ocean Platform	Sea Launch	11
Indian Ocean Platform	US	9
Palmachim	Israel	5
Hammaguir, Algeria	France	4
Svobodny	Russia	4
Woomera, Australia	Australia	4
Alcantara	Brazil	3
Barents Sea	Russia	1
Gando AB, Canary Islands	Spain	1
Kodiak, Alaska	US	1
Kwajalein, Marshall Islands	US	1
Musudan ri	North Korea	1
Total		4,643

Space on the Web

(Some of the space-related sites on the World Wide Web)

	Web address
Defense	
US Strategic Command	www.stratcom.mil
Air Force Space Command	www.peterson.af.mil/hqafspc
21st Space Wing	www.peterson.af.mil/21sw
30th Space Wing	www.vandenberg.af.mil
45th Space Wing	https://www.patrick.af.mil
50th Space Wing	www.schriever.af.mil
Space & Missile Systems Ctr.	www.losangeles.af.mil
Industry	
Boeing Integrated Defense Systems	www.boeing.com/ids
Lockheed Martin Space Systems Co.	www.ast.lmco.com
Northrop Grumman Space Technology	www.st.northropgrumman.com
Orbital Sciences	www.orbital.com
NASA	
Integrated Launch Schedule	www-pao.ksc.nasa.gov/kscpao/schedule/mixfleet.htm
Jet Propulsion Laboratory	www.jpl.nasa.gov
NASA Human Spaceflight	spaceflight.nasa.gov
Science @ NASA	science.nasa.gov
Space Center Houston	spacecenter.org
Other	
Florida Today	www.floridatoday.com/news/space/index.htm
Space.com, Inc.	www.space.com
Spaceweather.com	www.spaceweather.com

Space and Missile Badges



Space/Missile Badge



Astronaut Pilot*

* The astronaut designator indicates a USAF rated officer qualified to perform duties in space (50 miles and up) and who has completed at least one operational mission. Pilot wings are used here only to illustrate the position of the designator on the wings.



Missile Badge



Missile Badge with Operations Designerator

The Year in Space



July 15, 2003

US Broadcasting Board of Governors claims Cuba jammed Voice of America satellite TV broadcasts into Iran. Jamming was first detected July 6, and Telstar 12 service providers quickly found the source of the jamming to be located near Havana. Cuba issued a denial but said it would investigate.

Aug. 29

USAF launches last Defense Satellite Communications System III spacecraft into orbit aboard a Boeing Delta IV Evolved Expendable Launch Vehicle (EELV) from Cape Canaveral AFS, Fla.

Sept. 29

Lockheed Martin announces Northrop Grumman has joined with it and Orbital Sciences to compete for full-scale development of NASA's Orbital Spaceplane. Boeing is also vying for the OSP project.

Oct. 1

Air Force Reserve Command activates the 26th Space Aggressor Squadron, Schriever AFB, Colo., the third AFRC space squadron and first to serve in the space control mission area. It works with the active duty 527th SAS in Air Force Space Command's Space Warfare Center.

Oct. 16

China completes a manned space mission and joins the exclusive club of the US and Russia when it becomes the third country to send a person into space. Chinese officials said China plans to conduct space walks and space vehicle docking, establish a space lab, and begin exploring the moon within three years.

Oct. 18

USAF launches its final Titan II from Vandenberg AFB, Calif. The booster, which carried a Defense Meteorological Satellite Program spacecraft into orbit, was the 13th of 14 Cold War Titan II ICBMs Lockheed Martin refurbished for space launch. The 14th is expected to go into a museum.

Nov. 4

The 45th Space Wing announces transfer of Launch Complex 47 to the Florida Space Authority. The pad was slated for deactivation, but a licensing agreement under the Commercial Space Transportation Act permitted its continued operation and upkeep by FSA.

Nov. 19

The National Oceanic and Atmospheric Administration (NOAA) declares operational the first fully upgraded Block 5D-3 DMSP spacecraft, dubbed F16, after it undergoes a 30-day checkout, following its Oct. 18 launch (see above). NOAA is the designated operator for DMSPs, which provide data for strategic

and tactical weather prediction for US military forces.

Nov. 24

The National Imagery and Mapping Agency changes its name to the National Geospatial-Intelligence Agency (NGA).

Dec. 1

The 30th Space Wing, Vandenberg, and 45th SW, Patrick AFB, Fla., undergo realignments to streamline launch operations at each wing. The moves align former acquisition detachments at each base with some wing operations units to form the 30th Launch Group and 45th Launch Group, respectively.

Dec. 2

Lockheed Martin's final Atlas IIAS rocket carries a classified NRO payload into orbit from Vandenberg's Space Launch Complex-3 East, slated to undergo refurbishment to launch the new Atlas V EELV, beginning in fall 2005.

Dec. 2

NASA taps a USAF Reservist, Lt. Col. Michael E. Fossum, as a mission specialist for space shuttle flight STS-121, slated to fly no earlier than November 2004.

Jan. 5, 2004

USAF advances work toward the next generation Global Positioning Satellite, called GPS III, by awarding two system requirement contracts, one to Boeing and one to Lockheed Martin. Space and Missile Systems Center, Los Angeles AFB, Calif., expects to select one contractor in December 2005 for the GPS III development contract.

Jan. 14

President Bush unveils a new space exploration program with three major goals: first, completion of the ISS by 2010; second, development and testing of the Crew Exploration Vehicle (CEV) by 2008, with a manned flight by 2014; third, return to the moon by 2015, if possible, but not later than 2020. The CEV is expected to transport astronauts to the ISS after the space shuttle retires, but its main purpose is to carry spacefarers to other worlds.

Jan. 15

Schriever Air Force Base officials declare GPS IIR-10, launched Dec. 21, 2003, from Cape Canaveral Air Force Station, to be fully operational. The new satellite has an enhanced antenna panel to increase power output of the navigation signal, making it less susceptible to interference.

Jan. 30

USAF receives a prototype integrated air and space command and control (C2) capability developed by Lockheed Martin. The prototype, delivered to the C2 Transformation Center at Langley AFB, Va., provides a significant step

toward automated availability of space information for air operations centers worldwide and machine-to-machine data exchange for more cohesive planning between air and space command centers.

Feb. 14

A Boeing inertial upper stage launched atop a Titan IVB from Cape Canaveral boosts DSP-22 into orbit. It is the last launch in the 22-year run of the IUS program. The Titan IV-IUS combination is being replaced by EELVs.

March 20

The 50th GPS launches into orbit aboard a Boeing Delta II rocket from Cape Canaveral. The launch of GPS IIR-11 was dedicated to the late Ivan A. Getting, considered the father of GPS.

March 30

Boeing and Ball Aerospace announce win of the Space Based Surveillance System (SBSS) contract to develop a satellite and ground segment, provide launch services, and initially operate the new system. Northrop Grumman, as SBSS prime contractor, made the award to the Boeing-Ball team.

April 16

USAF begins first major step toward creation of the Space Based Radar (SBR) system by awarding concept development contracts to Lockheed Martin and Northrop Grumman. USAF expects to make final selection in 2006.

May 6

USAF Maj. James P. Dutton Jr., an F/A-22 test pilot, is named as one of two new space shuttle pilots. NASA also selects three other military personnel as new astronauts: Marine Maj. Randolph J. Bresnik, Lt. Cmdr. Christopher J. Cassidy, and Army Maj. Robert S. Kimbrough.

May 18

A space-based launch range moves a step closer to reality when USAF and Lockheed Martin successfully use a range instrumentation payload carried on an unmanned aircraft to track a Delta II rocket launched from Vandenberg. Lockheed's Range Systems Transformational Laboratory (RSTL) program tracked and recorded several minutes of telemetry data. USAF hopes the RSTL will prove the mobile launch range concept and lead to a space-based range that will eliminate the need for costly fixed range infrastructures.

June 23

US and European Union officials announce they have agreed on terms to make the EU's new Galileo satellite navigation system compatible with GPS. The agreement ended a long-running dispute. (See "Aerospace World: US, EU Set for NavSat Deal," March, p. 15.) ■

Military & Civilian Space Budgets

US Space Funding, Current Dollars (In millions)

EY	NASA	DOD	Other	Total
1959	\$261	\$490	\$34	\$785
1960	462	561	43	1,066
1961	926	814	68	1,808
1962	1,797	1,298	199	3,294
1963	3,626	1,550	257	5,433
1964	5,016	1,599	213	6,828
1965	5,138	1,574	241	6,953
1966	5,065	1,689	214	6,968
1967	4,830	1,664	213	6,707
1968	4,430	1,922	174	6,526
1969	3,822	2,013	170	6,005
1970	3,547	1,678	141	5,366
1971	3,101	1,512	162	4,775
1972	3,071	1,407	133	4,611
1973	3,093	1,623	147	4,863
1974	2,759	1,766	158	4,683
1975	2,915	1,892	158	4,965
1976	3,225	1,983	168	5,376
1977	3,440	2,412	194	6,046
1978	3,623	2,738	226	6,587
1979	4,030	3,036	248	7,314
1980	4,680	3,848	231	8,759
1981	4,992	4,828	234	10,054
1982	5,528	6,679	313	12,520
1983	6,328	9,019	327	15,674
1984	6,858	10,195	395	17,448
1985	6,925	12,768	584	20,277
1986	7,165	14,126	477	21,768
1987	9,809	16,287	466	26,562
1988	8,322	17,679	741	26,742
1989	10,097	17,906	560	28,563
1990	11,460	15,616	506	27,582
1991	13,046	14,181	772	27,999
1992	13,199	15,023	798	29,020
1993	13,064	14,106	731	27,901
1994	13,022	13,166	632	26,820
1995	12,543	10,644	759	23,946
1996	12,569	11,514	828	24,911
1997	12,457	11,727	789	24,973
1998	12,321	12,359	839	25,519
1999	12,459	13,203	982	26,644
2000	12,521	12,941	1,056	26,518
2001	13,304	14,326	1,062	28,692
2002	13,871	15,740	1,196	30,807
2003	14,360	19,388	1,305	35,053
Total	\$319,077	\$342,490	\$20,144	\$681,711

US Space Funding, Constant FY05 Dollars (In millions)

EY	NASA	DOD	Other	Total
1959	\$1,705	\$3,202	\$222	\$5,129
1960	2,968	3,604	276	6,849
1961	5,891	5,178	433	11,501
1962	11,318	8,175	1,253	20,746
1963	22,544	9,637	1,598	33,779
1964	30,786	9,814	1,307	41,908
1965	31,039	9,509	1,456	42,003
1966	29,735	9,916	1,256	40,907
1967	27,503	9,475	1,213	38,191
1968	24,209	10,503	952	35,664
1969	19,797	10,427	883	31,107
1970	17,382	8,223	691	26,296
1971	14,556	7,097	760	22,413
1972	13,968	6,400	607	20,974
1973	13,247	6,951	631	20,829
1974	10,645	6,814	610	18,069
1975	10,309	6,691	558	17,558
1976	10,780	6,629	563	17,972
1977	10,797	7,571	607	18,975
1978	10,568	7,987	659	19,214
1979	10,562	7,957	650	19,169
1980	10,807	8,886	534	20,226
1981	10,451	10,107	490	21,049
1982	10,897	13,166	616	24,680
1983	12,087	17,228	625	29,940
1984	12,560	18,671	723	31,954
1985	12,242	22,571	1,032	35,844
1986	12,430	24,506	827	37,763
1987	16,425	27,273	780	44,478
1988	13,387	28,438	1,192	43,016
1989	15,498	27,484	860	43,841
1990	16,689	22,741	736	40,166
1991	18,233	19,819	1,079	39,130
1992	17,909	20,384	1,082	39,375
1993	17,210	18,582	963	36,755
1994	16,720	16,904	812	34,436
1995	15,666	13,294	948	29,908
1996	15,241	13,962	1,004	30,207
1997	14,766	13,900	936	29,602
1998	14,375	14,419	979	29,773
1999	14,223	15,072	1,121	30,416
2000	13,823	14,287	1,165	29,276
2001	14,288	15,385	1,141	30,814
2002	14,662	16,638	1,264	32,564
2003	14,838	20,033	1,348	36,219
Total	\$675,736	\$595,509	\$39,443	\$1,310,688

Figures may not sum due to rounding. NASA totals represent space activities only. "Other" category includes the Departments of Energy, Commerce, Agriculture, Interior, and Transportation and the National Science Foundation.

People & Organizations



Space Leaders

(As of July 9, 2004)

US Strategic Command

Adm. James O. Ellis Jr. Oct. 1, 2002-July 9, 2004
 Gen. James E. Cartwright, USMC July 9, 2004-

US Space Command*

Gen. Robert T. Herres Sept. 23, 1985-Feb. 5, 1987
 Gen. John L. Piotrowski Feb. 6, 1987-March 30, 1990
 Gen. Donald J. Kutyna April 1, 1990-June 30, 1992
 Gen. Charles A. Horner June 30, 1992-Sept. 12, 1994
 Gen. Joseph W. Ashy Sept. 13, 1994-Aug. 26, 1996
 Gen. Howell M. Estes III Aug. 27, 1996-Aug. 13, 1998
 Gen. Richard B. Myers Aug. 14, 1998-Feb. 22, 2000
 Gen. Ralph E. Eberhart Feb. 22, 2000-Oct. 1, 2002

*US Space Command was inactivated Oct. 1, 2002, and its mission transferred to US Strategic Command.

Air Force Space Command

Gen. James V. Hartinger Sept. 1, 1982-July 30, 1984
 Gen. Robert T. Herres July 30, 1984-Oct. 1, 1986
 Maj. Gen. Maurice C. Padden Oct. 1, 1986-Oct. 29, 1987
 Lt. Gen. Donald J. Kutyna Oct. 29, 1987-March 29, 1990
 Lt. Gen. Thomas S. Moorman Jr. March 29, 1990-March 23, 1992
 Gen. Donald J. Kutyna March 23, 1992-June 30, 1992
 Gen. Charles A. Horner June 30, 1992-Sept. 13, 1994
 Gen. Joseph W. Ashy Sept. 13, 1994-Aug. 26, 1996
 Gen. Howell M. Estes III Aug. 26, 1996-Aug. 14, 1998
 Gen. Richard B. Myers Aug. 14, 1998-Feb. 22, 2000
 Gen. Ralph E. Eberhart Feb. 22, 2000-April 19, 2002
 Gen. Lance W. Lord April 19, 2002-

Army Space & Missile Defense Command*

Lt. Gen. John F. Wall July 1, 1985-May 24, 1988
 Brig. Gen. Robert L. Stewart May 24, 1988-July 11, 1988
 (acting)
 Lt. Gen. Robert D. Hammond July 11, 1988-June 30, 1992
 Brig. Gen. William J. Schumacher (acting) June 30, 1992-July 31, 1992
 Lt. Gen. Donald M. Lionetti Aug. 24, 1992-Sept. 6, 1994
 Lt. Gen. Jay M. Garner Sept. 6, 1994-Oct. 7, 1996
 Lt. Gen. Edward G. Anderson III Oct. 7, 1996-Aug. 6, 1998
 Col. Stephen W. Flohr (acting) Aug. 6, 1998-Oct. 1, 1998
 Lt. Gen. John Costello Oct. 1, 1998-March 28, 2001
 Brig. Gen. John M. Urias (acting) March 28, 2001-April 30, 2001
 Lt. Gen. Joseph M. Cosumano Jr. April 30, 2001-Dec. 16, 2003
 Lt. Gen. Larry J. Dodgen Dec. 16, 2003-

*Army Space and Missile Defense Command was the Army Strategic Defense Command until August 1992 and the Army Space and Strategic Defense Command until October 1997.

National Reconnaissance Office

Joseph V. Charyk Sept. 6, 1961-March 1, 1963
 Brockway McMillan March 1, 1963-Oct. 1, 1965
 Alexander H. Flax Oct. 1, 1965-March 11, 1969
 John L. McLucas March 17, 1969-Dec. 20, 1973
 James W. Plummer Dec. 21, 1973-June 28, 1976
 Thomas C. Reed Aug. 9, 1976-April 7, 1977
 Hans Mark Aug. 3, 1977-Oct. 8, 1979
 Robert J. Hermann Oct. 8, 1979-Aug. 2, 1981
 Edward C. Aldridge Jr. Aug. 3, 1981-Dec. 16, 1988
 Martin C. Faga Sept. 26, 1989-March 5, 1993
 Jeffrey K. Harris May 19, 1994-Feb. 26, 1996
 Keith R. Hall (acting) Feb. 27, 1996-March 27, 1997
 Keith R. Hall March 28, 1997-Dec. 13, 2001
 Peter B. Teets Dec. 13, 2001-

Naval Network & Space Operations Command

RAdm. John P. Cryer July 12, 2002-

Naval Space Command*

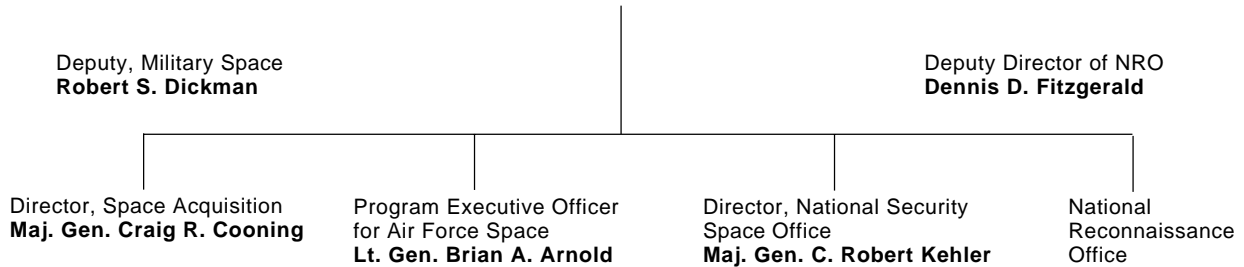
RAdm. Richard H. Truly Oct. 1, 1983-Feb. 28, 1986
 Col. Richard L. Phillips, USMC March 1, 1986-April 30, 1986
 (acting)
 RAdm. D. Bruce Cargill April 30, 1986-Oct. 24, 1986
 RAdm. Richard C. Macke Oct. 24, 1986-March 21, 1988
 RAdm. David E. Frost March 21, 1988-April 2, 1990
 Col. Charles R. Geiger, USMC April 2, 1990-May 31, 1990
 (acting)
 RAdm. L.E. Allen Jr. May 31, 1990-Aug. 12, 1991
 RAdm. Herbert A. Browne Jr. Aug. 12, 1991-Oct. 28, 1993
 RAdm. Leonard N. Oden Oct. 28, 1993-Jan. 31, 1994
 RAdm. Lyle G. Bien Jan. 31, 1994-Dec. 13, 1994
 RAdm. Phillip S. Anselmo Dec. 13, 1994-April 18, 1995
 RAdm. Katharine L. Laughton April 18, 1995-Feb. 28, 1997
 RAdm. Patrick D. Moneymaker Feb. 28, 1997-Sept. 10, 1998
 Col. Michael M. Henderson, USMC (acting) Sept. 10, 1998-Oct. 1, 1998
 RAdm. Thomas E. Zelibor Oct. 1, 1998-June 8, 2000
 RAdm. J.J. Quinn June 8, 2000-March 31, 2001
 RAdm. Richard J. Mauldin March 31, 2001-Dec. 10, 2001
 RAdm. John P. Cryer Dec. 10, 2001-July 12, 2002

*Naval Space Command and Naval Network Operations Command merged July 12, 2002.

USECAF/DNRO Organization

(As of July 1, 2004)

Undersecretary of the Air Force and
Director, National Reconnaissance Office
Peter B. Teets



Air Force Space Command, Peterson AFB, Colo.

(As of July 1, 2004)

Commander
Gen. Lance W. Lord

Space and Missile Systems Center
Hq., Los Angeles AFB, Calif.
Cmdr.: **Lt. Gen. Brian A. Arnold**

- DMSP Program Office
- Evolved Expendable Launch Vehicle PO
- Launch Programs PO
- MILSATCOM Joint Program Office
- Navstar Global Positioning System JPO
- Satellite and Launch Control PO
- Space Based Infrared Systems PO
- Space Based Radar JPO
- Space Superiority System Program Office

Space Warfare Center
Schriever AFB, Colo.
Cmdr.: **Maj. Gen. (sel.) Daniel J. Darnell**

14th Air Force
Hq., Vandenberg AFB, Calif.
Cmdr.: **Maj. Gen. Michael A. Hamel**

- 21st Space Wing**, Peterson AFB, Colo.
- 30th Space Wing**, Vandenberg AFB, Calif.
- 45th Space Wing**, Patrick AFB, Fla.
- 50th Space Wing**, Schriever AFB, Colo.
- 460th Air Base Wing**, Buckley AFB, Colo.

20th Air Force
Hq., F.E. Warren AFB, Wyo.
Cmdr.: **Maj. Gen. Frank G. Klotz**

- 90th Space Wing**, F.E. Warren AFB, Wyo.
- 91st Space Wing**, Minot AFB, N.D.
- 341st Space Wing**, Malmstrom AFB, Mont.

Major Military Space Commands

Unified Command	Personnel	FY05 Budget	Functions
US Strategic Command Offutt AFB, Neb.	3,738	\$497 million	Establishes and provides full-spectrum global strike, coordinated space and information operations capabilities to meet both deterrent and decisive national security objectives. Provides operational space support and integrated missile defense. Provides global C4ISR, as well as specialized planning expertise to the joint warfighter.
Service Commands			
Air Force Space Command Peterson AFB, Colo.	26,550	\$9.4 billion	Operates military space systems, ground-based missile-warning radars and sensors, missile-warning satellites, national launch centers, and ranges; tracks space debris; operates and maintains the USAF ICBM force.
Naval Network & Space Operations Command Dahlgren, Va.	4,834	\$273 million	Operates and maintains the Navy's space and global telecommunications systems and services, directly supports warfighting operations and command and control of naval forces, and promotes innovative technological solutions to warfighting requirements.
Army Space & Missile Defense Command Arlington, Va.	1,832	\$678.5 million	Manages Army space and information operations and global strike, integrated missile defense, and C4ISR capabilities; provides worldwide space support, including employment of satellite communications and theater missile warning to warfighters; oversees Army space and missile R&D and development of Army space doctrine and concepts.

Central Intelligence Agency (CIA)
Headquarters: McLean, Va.
Established: 1947
Director: John E. McLaughlin (acting)

Mission, Purpose, Operations

The CIA's Directorate for Science and Technology includes the Office of Development and Engineering, which develops systems from requirements definition through design, testing, and evaluation to operations. Works with systems not available commercially. Disciplines include laser communications, digital imagery processing, real-time data collection and processing, electro-optics, advanced signal collection, artificial intelligence, advanced antenna design, mass data storage and retrieval, and large systems modeling and simulations. Work includes new concepts and systems upgrades.

Structure

Classified.

Personnel

Classified.

National Geospatial-Intelligence Agency (NGA)

Headquarters: Bethesda, Md.
Established: Nov. 24, 2003
Director: James R. Clapper Jr.

Mission, Purpose, Operations

NGA is both a national intelligence and a combat support agency whose mission is to provide timely, relevant, and accurate geospatial intelligence in support of national security. Geospatial intelligence is the exploitation and analysis of imagery and geospatial information to describe, assess, and visually depict physical features and geographically referenced activities on the Earth.

Structure

Major facilities in Washington D.C., Northern Virginia, and St. Louis areas, with NGA support teams worldwide.

Personnel

Classified.

Formerly National Imagery and Mapping Agency (NIMA).

National Reconnaissance Office (NRO)

Headquarters: Chantilly, Va.
Established: September 1961
Director: Peter B. Teets

Mission, Purpose, Operations

Design, build, and operate reconnaissance satellites to support global information superiority for the US. It has operated hundreds of satellites since it was formed in 1960 and officially recognized in 1961. Responsible for innovative technology; systems engineering; development, acquisition, and operation of space reconnaissance systems; and related intelligence activities. Supports monitoring of arms control agreements, military operations and exercises, natural disasters, environmental issues, and worldwide events of interest to the US.

Structure

NRO is a DOD agency, funded through part of the National Foreign Intelligence Program, known as the National Reconnaissance Program. Both the Secretary of Defense and Director of Central Intelligence have approval of the program. The NRO has one office (space launch) and four directorates (signals intelligence systems acquisition and operations, communications systems acquisition and operations, imagery intelligence systems acquisition and operations, and advanced systems and technology) that report to the director.

Personnel

Staffed by CIA (41 percent), USAF (49 percent), Navy/Marines (nine percent), Army (one percent). Exact personnel numbers are classified.

National Security Agency (NSA)

Headquarters: Ft. Meade, Md.
Established: 1952
Director: USAF Lt. Gen. Michael V. Hayden

Mission, Purpose, Operations

Protect US communications and produce foreign intelligence information. Tasked with two primary missions: an information assurance mission and a foreign signals intelligence mission. To accomplish these missions, the director's responsibilities include: prescribing security principles, doctrines, and procedures for the government; organizing, operating, and managing certain activities and facilities to produce foreign intelligence information; and conducting defensive information operations.

Structure

Established by a Presidential directive in 1952 as a separately organized agency within DOD under the direction, authority, and control of the Secretary of Defense, who serves as the executive agent of the US government for the foreign signals intelligence and communications security activities of the government. A 1984 Presidential directive charged the agency with an additional mission: computer security. An operations security training mission was added in 1988. The Central Security Service was established in 1972 by a Presidential memorandum to provide a more unified cryptological organization within DOD. The NSA director also serves as chief of the CSS.

Personnel

Approx. 30,000 worldwide.



A Titan IVB rocket launches a classified payload for USAF and NRO from Complex-4 East at Vandenberg AFB, Calif.

Space Operations

US Space Launch Sites

Military Sites (Orbital)

Cape Canaveral AFS, Fla.

Location: 28.5° N, 80° W.

Mission/operations: USAF's East Coast launch site. Launches satellites into geosynchronous orbit via ELVs. Hub of Eastern Range operations for civil, military, and commercial space launches and military ballistic missile tests.

Launches: 599.

Launch vehicles: Athena I, II; Atlas II, III, V; Delta II, III, IV; Titan IV.

History: Designated simply as Operating Sub-Division #1 in 1950, it became Cape Canaveral Missile Test Annex and, for a time, Cape Kennedy Air Force Station, then Cape Canaveral Air Force Station in 1974.

Acres: 15,700.

Vandenberg AFB, Calif.

Location: 35° N, 121° W.

Mission/operations: USAF's West Coast launch site. Launches satellites into polar orbits via ELVs; sole site for test launches of USAF ICBM fleet; basic support for R&D tests for DOD, USAF, and NASA space, ballistic missile, and aeronautical systems; facilities and essential services for more than 60 aerospace contractors on base.

Launches: 626.

Launch vehicles: Athena I; Atlas II, III, V; Delta II, III, IV; Pegasus; Taurus; Titan II, IV.

History: Originally Army's Camp Cooke, turned over to Air Force January 1957. Renamed Vandenberg Oct. 4, 1958.

Acres: 98,400.

Civil/Commercial Sites (Orbital)

Alaska Spaceport

Location: 57.5° N, 153° W.

Mission/operations: Commercial launch facility for polar and near-polar launches of communications, remote sensing, and scientific satellites up to 8,000 pounds.

Launches: Six.

Launch vehicles: Athena I, suborbital.

History: Established in 1998; funded through Alaska Aerospace Development Corp.

Acres: 3,100.

Florida Space Authority

Location: 28.5° N, 80° W.

Mission/operations: Various launch complexes and support facilities developed, operated, or financed by the state of Florida at the Cape Canaveral Spaceport (comprising Cape Canaveral Air Force Station and Kennedy Space Center). FSA developed or owns infrastructure at launch complexes 37, 41, 46, and 47 and manages a multiuser launch control facility, space experiments research and processing laboratory, and other facilities.

Launches: N/A

Launch vehicles: Athena I, II; Minotaur; Minuteman III; Taurus; Terrier.

History: Established in 1989.

John F. Kennedy Space Center, Fla.

Location: 28° N, 80° W.

Mission/operations: NASA's primary launch base for space shuttle.

Launches: 134.

Launch vehicles: Pegasus, space shuttle, Taurus.

History: NASA began acquiring land across the Banana River from Cape Canaveral in 1962. By 1967, its first launch complex—Complex 39—was operational. KSC facilities were modified in the mid to late 1970s to accommodate the space shuttle program.

Acres: 140,000 (land and water).

Mid-Atlantic Regional Spaceport

Location: 38° N, 76° W (at NASA

Wallops Flight Facility).

Mission/operations: State-owned launch facility cooperatively operated by Virginia and Maryland for access to inclined and sun-synchronous orbits; recovery support for ballistic and guided re-entry vehicles; vehicle and payload storage and processing facilities; two commercially licensed launchpads and suborbital launch rails for commercial,

military, scientific, and experimental launch customers.

Operator: CSC-DynSpace.

Launches: 13 (since 1995).

Launch vehicles: Athena I, II; Black Brant; Falcon; Lockheed Martin HYSR; Minotaur; Orion; Pegasus; Taurus; Terrier.

Sea Launch

Location: Equator, 154° W, Pacific Ocean.

Mission/operations: Provide heavy lift GTO launch services for commercial customers worldwide. Sea Launch is owned by an international partnership: Boeing, RSC Energia, Anglo-Norwegian Kvaerner Group, and SDO Yuzhnoye/PO Yuzhmash.

Launches: 11.

Launch vehicles: Zenit-3SL.

History: Established in April 1995; demonstration launch March 1999.

Spaceport Systems Intl., L.P.

Location: 34.70° N, 120.46° W.

Mission/operations: Polar and near-polar LEO launches from Vandenberg; payload processing and launches for commercial, NASA, and USAF customers; small to medium launch vehicles up to one million pound thrust; payload processing facility for small and heavy satellites.

Launches: Two.

Launch vehicles: MM II class.

History: SSL, a limited partnership formed by ITT and California Commercial Spaceport, Inc., achieved full operational status of the spaceport in May 1999.

Wallops Flight Facility, Va.

Location: 38° N, 76° W.

Mission/operations: East Coast launch site and research airport.

Launches: 30.

Launch vehicles: 14 suborbital sounding rockets.

History: Established in 1945, it is one of world's oldest launch sites.

Acres: 6,166.

Note: Launches 1957-2003, except where noted.

Military Functions in Space

Communications

Provide communications from national leaders to joint force commander and from JFC to squadron-level commanders. Allow beyond-line-of-sight command and control of forces. Support transmission of situational awareness and imagery to tactical-level operations. Permit rapid transmission of JFC intent, ground force observations, and adaptive planning.

Environmental/Remote Sensing

Use space systems to create topographical, hydrographic, and geological maps and charts and to develop systems of topographic measurement.

Force Application

US Strategic Command is identifying potential future roles, missions, and systems, which, if authorized by civilian leadership for development and deployment, could attack terrestrial and space targets from space in support of national defense.

Missile Defense

Employ space assets to support identification, acquisition, tracking, and destruction of ballistic and cruise missiles launched against forward deployed US forces, allied forces, or US territory.

Navigation and Timing

Provide highly accurate time and three-dimensional position and velocity information to an unlimited number of suitably equipped military users any-

where on or above the Earth's surface, in any weather. Enable weapons guidance. Provide a common time reference for network and communications synchronization. Provide precise timing and location information aids in navigation, situational awareness, and combat search and rescue.

On-Orbit Support

Track and control satellites, operate their payloads, and disseminate data from them.

Reconnaissance and Surveillance

Observation of space, air, and surface areas through visual, electronic, photographic, or other means to provide situational awareness of a given area or activity. Access to specific targets, allowing data collection focused on specific events of interest. Enhance the reaction time of information users and cue other systems. Support the full range of intelligence activities and operational mission planning and execution.

Space Control

Control and exploit space using offensive and defensive measures to ensure that friendly forces can use space capabilities, while denying their use to the enemy. The ability to execute offensive and defensive measures is predicated on precise space situational awareness. Space situational awareness is an understanding of all space-related activity, both on the ground and in space. This mission is assigned to

commander, STRATCOM, in the Unified Command Plan.

Space-Based Global Environmental Monitoring

Collect global high-resolution cloud imagery and other critical air, land, sea, and space environment data to optimize war planning and execution.

Spacelift

Oversee satellite and booster preparation and integration. Conduct launch countdown activities. Operate Eastern and Western Ranges to support the safe conduct of spacelift missions, ballistic missile test and evaluations, and aeronautical/guided weapons test and evaluations.

Strategic and Theater Early Warning

Operate satellites to give national leaders early warning of all strategic missile events and combatant commanders/warfighters early warning of all theater ballistic missile events. Provide timely, accurate data on launch times, locations, and predicted impact areas. Cue passive and active missile defense systems.

Tactical Warning/Attack Assessment

Execute the NORAD mission calling for use of all sensors to detect and characterize an attack on US or Canadian territory. STRATCOM carries out similar tactical warning in other theaters.

Boeing photo



The Florida coastline is visible below this Delta II rocket as its solid-fuel boosters fall away while the launch vehicle continues on. This photo, taken from a Boeing video, depicts the launch of NASA's Mars Odyssey payload.

US Military/Civil Launches

(As of Dec. 31, 2003)

Launch Year	Military	Civil*	Total
1958	0	7	7
1959	6	5	11
1960	11	5	16
1961	19	10	29
1962	32	20	52
1963	25	13	38
1964	33	24	57
1965	34	29	63
1966	35	38	73
1967	29	29	58
1968	23	22	45
1969	17	23	40
1970	18	11	29
1971	16	16	32
1972	14	17	31
1973	11	12	23
1974	8	16	24
1975	9	19	28
1976	11	15	26
1977	10	14	24
1978	14	18	32
1979	8	8	16
1980	8	5	13
1981	7	11	18
1982	6	12	18
1983	8	14	22
1984	11	11	22
1985	4	13	17
1986	4	2	6
1987	6	2	8
1988	8	4	12
1989	11	7	18
1990	11	16	27
1991	6	12	18
1992	11	17	28
1993	12	11	23
1994	11	15	26
1995	9	18	27
1996	11	22	33
1997	9	28	37
1998	5	29	34
1999	7	23	30
2000	11	17	28
2001	7	14	21
2002	1	16	17
2003	11	16	27
Total	578	706	1,284

US Satellites Placed in Orbit and Deep Space

(As of Dec. 31, 2003)

Launch Year	Military	Civil*	Total
1958	0	7	7
1959	6	5	11
1960	12	5	17
1961	20	12	32
1962	35	20	55
1963	33	22	55
1964	44	25	69
1965	49	39	88
1966	52	47	99
1967	51	34	85
1968	35	26	61
1969	32	27	59
1970	23	8	31
1971	26	18	44
1972	18	14	32
1973	14	10	24
1974	11	8	19
1975	12	16	28
1976	17	12	29
1977	14	6	20
1978	16	17	33
1979	10	7	17
1980	12	4	16
1981	7	10	17
1982	8	9	17
1983	16	12	28
1984	17	16	33
1985	13	17	30
1986	7	4	11
1987	10	1	11
1988	11	9	20
1989	15	9	24
1990	22	16	38
1991	17	18	35
1992	12	17	29
1993	12	18	30
1994	18	19	37
1995	15	24	39
1996	16	24	40
1997	10	82	92
1998	7	90	97
1999	8	73	81
2000	12	40	52
2001	8	23	31
2002	2	25	27
2003	11	12	23
Total	816	957	1,773

Note: Data changes in prior years in the table above are based on recategorization of civil to military launches.

*Includes some military payloads.

Upcoming Shuttle Flights

Month/Year*	Mission	Name
March 2005	STS-114	<i>Discovery</i>
TBD	STS-121	TBD
TBD	STS-115	TBD
TBD	STS-116	TBD

*Flight dates beyond March 2005 are under review following the February 2003 loss of *Columbia* and its crew.

US Military Payloads by Mission, 1958-2003 (Orbital only)

Category	Number
Applications	345
<i>Communications</i>	125
<i>Weather</i>	44
<i>Navigation</i>	91
<i>Launch vehicle/spacecraft tests</i>	3
<i>Other military</i>	82
Weapons-Related Activities	46
<i>SDI tests</i>	11
<i>Antisatellite targets</i>	2
<i>Antisatellite interceptors</i>	33
Reconnaissance	436
<i>Photographic/radar imaging</i>	250
<i>Electronic intelligence</i>	49
<i>Ocean surveillance</i>	46
<i>Nuclear detection</i>	12
<i>Radar calibration</i>	40
<i>Early warning</i>	39
Total	827

US Manned Spaceflights

Year	Flights	Persons
1961	2	2
1962	3	3
1963	1	1
1964	0	0
1965	5	10
1966	5	10
1967	0	0
1968	2	6
1969	4	12
1970	1	3
1971	2	6
1972	2	6
1973	3	9
1974	0	0
1975	1	3
1976	0	0
1977	0	0
1978	0	0
1979	0	0
1980	0	0
1981	2	4
1982	3	8
1983	4	20
1984	5	28
1985	9	58
1986	1	7
1987	0	0
1988	2	10
1989	5	25
1990	6	32
1991	6	35
1992	8	53
1993	7	42
1994	7	42
1995	7	42
1996	7	43
1997	8	53
1998	5	33
1999	3	19
2000	5	32
2001	6	38
2002	5	34
2003	1	7
Total	143	736

USAF photo by 1st Lt. Warren Comer



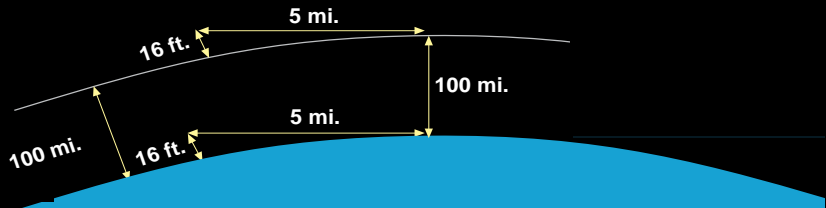
A Titan IVB rocket is unloaded from a C-5 at Cape Canaveral AFS, Fla. This booster is scheduled for launch in late 2004.



This Boeing Delta II rocket is lifting off from Cape Canaveral AFS in Florida. It carries into orbit a replacement satellite for USAF's Global Positioning System.

Orbits

Orbits result from the mutual attraction of any two bodies with a force proportional to the product of their individual masses and inversely proportional to the square of the distance between them. The curvature of the Earth, on average, drops 16 feet below the horizontal over a distance of about five miles. A spacecraft circling above would "fall" that same amount over the same distance. It travels five miles in one second if gravitational pull equals one G. Therefore, spacecraft velocity of five miles per second (18,000 mph) produces perpetual orbit at sea level, unless the spacecraft's flight is upset by perturbations, such as solar wind or mechanical anomalies.

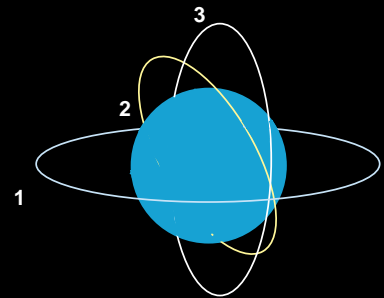
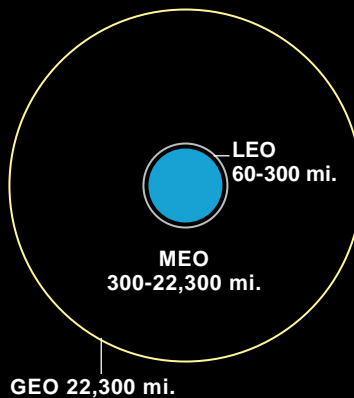


Orbital Altitude

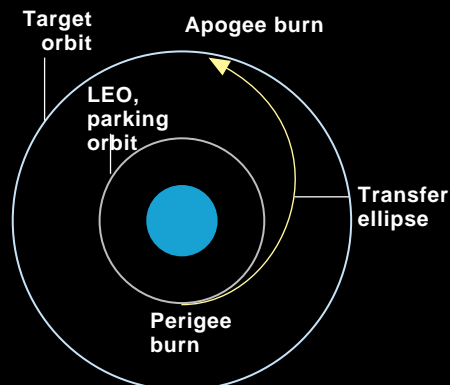
- LEO Low Earth orbit
- MEO Medium Earth orbit
- GEO Geosynchronous Earth orbit
- HEO High Earth orbit

Orbital Inclinations

- 1 Equatorial
- 2 Sun synchronous
- 3 Polar



Geosynchronous Transfer Orbit



It is common procedure to pick an initial "parking" orbit, usually at LEO, then boost payloads to higher altitude. Engines are fired first (at perigee) to reach the apogee of an elliptical transfer orbit and then are fired again to put the spacecraft into a circular orbit at that higher altitude.

Illustrations are not drawn to scale.

Space Shuttle Flights, 1981-2004

(As of June 19, 2004)

Flight	Mission	Launch	Return	Flight	Mission	Launch	Return
1	STS-1	4/12/81	4/14/81	58	STS-58	10/18/93	11/1/93
2	STS-2	11/12/81	11/14/81	59	STS-61	12/2/93	12/13/93
3	STS-3	3/22/82	3/30/82	60	STS-60	2/3/94	2/11/94
4	STS-4*	6/27/82	7/4/82	61	STS-62	3/4/94	3/18/94
5	STS-5	11/11/82	11/16/82	62	STS-59	4/9/94	4/20/94
6	STS-6	4/4/83	4/9/83	63	STS-65	7/8/94	7/23/94
7	STS-7	6/18/83	6/24/83	64	STS-64	9/9/94	9/20/94
8	STS-8	8/30/83	9/5/83	65	STS-68	9/30/94	10/11/94
9	STS-9	11/28/83	12/8/83	66	STS-66	11/3/94	11/14/94
10	STS-10	2/3/84	2/11/84	67	STS-63	2/3/95	2/11/95
11	STS-11	4/6/84	4/13/84	68	STS-67	3/2/95	3/18/95
12	STS-12	8/30/84	9/5/84	69	STS-71	6/27/95	7/7/95
13	STS-13	10/5/84	10/13/84	70	STS-70	7/13/95	7/22/95
14	STS-14	11/8/84	11/16/84	71	STS-69	9/7/95	9/18/95
15	STS-15*	1/24/85	1/27/85	72	STS-73	10/20/95	11/5/95
16	STS-16	4/12/85	4/19/85	73	STS-74	11/12/95	11/20/95
17	STS-17	4/29/85	5/6/85	74	STS-72	1/11/96	1/20/96
18	STS-18	6/17/85	6/24/85	75	STS-75	2/22/96	3/9/96
19	STS-19	7/29/85	8/6/85	76	STS-76	3/22/96	3/31/96
20	STS-20	8/27/85	9/3/85	77	STS-77	5/19/96	5/29/96
21	STS-21*	10/3/85	10/7/85	78	STS-78	6/20/96	7/7/96
22	STS-22	10/30/85	11/6/85	79	STS-79	9/16/96	9/26/96
23	STS-23	11/26/85	12/3/85	80	STS-80	11/19/96	12/7/96
24	STS-24	1/12/86	1/18/86	81	STS-81	1/12/97	1/22/97
25	STS-25	1/28/86	No Landing	82	STS-82	2/11/97	2/21/97
26	STS-26	9/29/88	10/3/88	83	STS-83	4/4/97	4/8/97
27	STS-27*	12/2/88	12/6/88	84	STS-84	5/15/97	5/24/97
28	STS-29	3/13/89	3/18/89	85	STS-94	7/1/97	7/17/97
29	STS-30	5/4/89	5/8/89	86	STS-85	8/7/97	8/19/97
30	STS-28*	8/8/89	8/13/89	87	STS-86	9/25/97	10/6/97
31	STS-34	10/18/89	10/23/89	88	STS-87	11/19/97	12/5/97
32	STS-33*	11/22/89	11/27/89	89	STS-89	1/22/98	1/31/98
33	STS-32	1/9/90	1/20/90	90	STS-90	4/17/98	5/3/98
34	STS-36*	2/28/90	3/4/90	91	STS-91	6/2/98	6/12/98
35	STS-31	4/24/90	4/29/90	92	STS-95	10/29/98	11/7/98
36	STS-41	10/6/90	10/10/90	93	STS-88	12/4/98	12/15/98
37	STS-38*	11/15/90	11/20/90	94	STS-96	5/27/99	6/6/99
38	STS-35	12/2/90	12/10/90	95	STS-93*	7/22/99	7/27/99
39	STS-37	4/5/91	4/11/91	96	STS-103	12/19/99	12/27/99
40	STS-40	6/5/91	6/14/91	97	STS-99	2/11/00	2/22/00
41	STS-43	8/2/91	8/11/91	98	STS-101	5/19/00	5/29/00
42	STS-48	9/12/91	9/18/91	99	STS-106*	9/8/00	9/19/00
43	STS-44*	11/24/91	12/1/91	100	STS-92	10/11/00	10/24/00
44	STS-39*	4/28/91	5/6/91	101	STS-97	11/30/00	12/11/00
45	STS-42	1/22/92	1/30/92	102	STS-98*	2/7/01	2/20/01
46	STS-45	3/24/92	4/2/92	103	STS-102*	3/8/01	3/20/01
47	STS-49	5/7/92	5/16/92	104	STS-100	4/19/01	5/1/01
48	STS-50	6/25/92	7/9/92	105	STS-104*	7/12/01	7/24/01
49	STS-46	7/31/92	8/8/92	106	STS-105*	8/10/01	8/22/01
50	STS-47	9/12/92	9/20/92	107	STS-108	12/5/01	12/17/01
51	STS-52	10/22/92	11/1/92	108	STS-109	3/1/02	3/9/02
52	STS-53*	12/2/92	12/9/92	109	STS-110	4/8/02	4/19/02
53	STS-54	1/13/93	1/19/93	110	STS-111	6/5/02	6/19/02
54	STS-56	4/8/93	4/17/93	111	STS-112	10/7/02	10/18/02
55	STS-55	4/26/93	5/6/93	112	STS-113	11/23/02	12/7/02
56	STS-57	6/21/93	7/1/93	113	STS-107	1/16/03	No Landing
57	STS-51	9/12/93	9/22/93				

*DOD payload.



Major Military Satellite Systems

Advanced Extremely High Frequency Satellite Communications System

Common name: AEHF

In brief: successor to Milstar, AEHF will provide assured strategic/tactical, worldwide C2 communications with at least five times the capacity of Milstar II but in a smaller package.

Function: EHF communications.

Operator: MILSATCOM JPO (acquisition); AFSPC.

First launch: December 2006, planned.

Constellation: three-five.

Orbit altitude: 22,300 miles.

Contractor: Lockheed Martin, Northrop Grumman team for system development and demonstration.

Power plant: N/A.

Dimensions: N/A.

Weight: approx 13,000 lb.

Advanced Polar System

Common name: APS

In brief: next generation polar communications to replace interim polar system (see Polar Military Satellite Communications, p. 44), which provides only a fraction of the polar communications capability required by aircraft, submarines, and other forces operating in the high northern latitudes. Pre-acquisition, system definition, and risk reduction efforts started in Fiscal 2004.

Function: EHF communications.

Operator: MILSATCOM JPO (acquisition); AFSPC.

First launch: circa 2010.

Constellation: two.

Orbit altitude: 22,300+ miles.

Contractor: TBD.

Power plant: TBD.

Dimensions: TBD.

Weight: TBD.

Advanced Wideband System

Common name: AWS

In brief: successor to the Defense Satellite Communications System (see at right) and the Wideband Gap-Filler System (see p. 44). Current concept calls for commercial-like satellites, with high-capacity SHF, Internet protocols, and laser crosslink (possible), to provide greatly increased tactical communications capability for aircraft and mobile ground forces.

Function: wideband communications.

Operator: MILSATCOM JPO (acquisition); AFSPC.

First launch: 2009, planned.

Constellation: three-six, planned.

Orbit altitude: 22,300 miles.

Contractor: TBD.

Power plant: TBD.

Dimensions: TBD.

Weight: TBD.

Defense Meteorological Satellite Program

Common name: DMSP

In brief: satellites that collect air, land, sea, and space environmental data to support worldwide strategic and tactical military operations. Operational control transferred to NOAA in 1998; backup operation center at Schriever AFB, Colo., manned by Air Force Reserve Command personnel.

Function: environmental monitoring.

Operator: NPOESS Integrated Program Office.

First launch: May 23, 1962.

Constellation: two (primary).

Orbit altitude: approx 575 miles.

Contractor: Lockheed Martin, Northrop Grumman.

Power plant: solar arrays, 1,200-1,300 watts.

Dimensions: 4 x 20.2 ft deployed.

Weight: 2,545 lb (including 592-lb sensor).

Defense Satellite Communications System III

Common name: DSCS

In brief: nuclear-hardened and jam-resistant spacecraft used to transmit high-priority C2 messages to battlefield commanders.

Function: SHF communications.

Operator: AFSPC.

First launch: October 1982.

Constellation: five.

On orbit: 13.

Orbit altitude: 22,000+ miles.

Contractor: Lockheed Martin.

Power plant: solar array, avg. 1,269 watts (pre-system life enhancement program); avg. 1,500 watts (SLEP; first SLEP satellite launched Jan. 20, 2000).

Dimensions: 6 x 6 x 7 ft; 38 ft deployed.

Weight: 2,580 lb (pre-SLEP); 2,716 lb (SLEP).

Defense Support Program

Common name: DSP

In brief: early warning spacecraft whose infrared sensors detect heat generated by a missile or booster plume.

Function: strategic and tactical missile launch detection.

Operator: AFSPC.

First launch: November 1970.

Constellation: classified.

On orbit: classified.

Orbit altitude: 22,000+ miles.

Contractor: Northrop Grumman.

Power plant: solar array, 1,485 watts.

Dimensions: 22 x 32.8 ft deployed.

Weight: approx 5,000 lb.

Global Broadcast System

Common name: GBS

In brief: wideband communications program, initially using leased commercial satellites, then military systems, to provide digital multimedia data directly to theater warfighters.

Function: high-bandwidth data imagery and video.

Operator: Navy.

First launch: March 1998 (Phase 2 payload on UHF Follow-On).

Constellation: three; commercial augmentation.

On orbit: three.

Orbit altitude: 23,230 miles.

Contractor: Raytheon (Phase 2).

Power plant: (interim host satellite: UHF Follow-On) 3,800 watts.

Dimensions: numerous items integrated throughout host.

Global Positioning System

Common name: GPS

In brief: constellation of satellites used by military and civilians to determine a precise location and time anywhere on Earth. Block IIR began replacing older GPS spacecraft in mid-1997; first modified Block IIR-M with military (M-code) on two channels launches in 2004. Next generation Block IIF with extended design life, faster processors, and new civil signal on third frequency launches in 2006. Generation after next GPS III with advanced antijam and higher quality data is slated for initial launch in 2012.

Function: worldwide navigation.

Operator: AFSPC.

First launch: Feb. 22, 1978 (Block I).

Constellation: 28.

Orbit altitude: 12,600 miles.

Contractor: Boeing (II, IIA, IIF);

Lockheed Martin (IIR, IIR-M).

Power plant: solar array, 1,136 watts

(IIR/IIR-M); up to 2,900 watts (IIF).

Dimensions: 5 x 6.3 x 6.25 ft; 38 ft

deployed (IIR/IIR-M); 12.9 x 43.1 ft

deployed (IIF).

Weight: 2,370 lb (IIR/IIR-M); 3,407 lb (IIF).

Milstar Satellite Communications System

Common Name: Milstar

In brief: joint communications satellite that provides secure, jam-resistant communications for essential wartime needs.

Function: EHF communications.

Operator: AFSPC.

First launch: Feb. 7, 1994.

Constellation: five.

On orbit: five.
Orbit altitude: 22,300 miles.
Contractor: Lockheed Martin (prime), with Boeing, Northrop Grumman.
Power plant: solar array, 8,000 watts.
Dimensions: 51 ft; 116 ft deployed.
Weight: approx 10,000 lb.

Mobile User Objective System (also known as Advanced Narrowband System)

Common name: MUOS
In brief: next generation narrowband UHF tactical communications satellite to replace the UHF Follow-On Satellite (see below at right). Concept study contracts awarded in 1999; production award expected in summer 2004; initial launch in 2007.

Function: UHF tactical communications.
Operator: Navy.
First launch: 2009, planned.
Constellation: four, plus spare.
On orbit: none.
Orbit altitude: 22,300 miles.
Contractor: TBD.
Power plant: TBD.
Dimensions: TBD.
Weight: TBD.

Polar Military Satellite Communications (also known as Interim Polar and Adjunct Polar)

Common name: Polar MILSATCOM
In brief: USAF deployed a modified Navy EHF payload on a host polar-orbiting satellite to provide an interim solution to ensure warfighters have protected polar communications capability. Polars 2 and 3 slated for launch in 2004 and 2006, respectively.
Function: EHF polar communications.
Operator: Navy.
First launch: 1997.
Constellation: three.
On orbit: one.
Orbit altitude: 25,300 miles (apogee).
Contractor: classified.
Power plant: 410 watts consumed by payload (power from host solar array).
Dimensions: numerous items integrated throughout host.
Weight: 470 lb.

Space Based Infrared System High

Common name: SBIRS High
In brief: advanced surveillance system for missile warning, missile defense, battlespace characterization, and technical intelligence. System initially will complement, then replace, Defense Support Program spacecraft (see p. 43).
Function: infrared space surveillance.
Operator: AFSPC.
First launch: 2007, planned.
Constellation: four GEO sats, plus one on-orbit spare, and two sensors in highly elliptical orbit.
On orbit: none.
Contractor: Lockheed Martin, Northrop Grumman.
Power plant: solar array, 2,435 watts.
Dimensions: 6 x 7 x 17 ft.
Weight: 5,442 lb.

Space Based Radar



Pictured is an artist's conception of the Wideband Gap-Filler System, meant to bridge the gap between current and future communication satellites.

Common name: SBR
In brief: spaceborne capability to track moving targets in operational theater.
Function: track moving ground targets.
Operator: SMC/NRO JPO (development/acquisition); AFSPC.
First launch: 2012, planned.
Constellation: TBD.
On orbit: none.
Contractor: Lockheed Martin and Northrop Grumman leading concept development efforts. Final selection planned for 2006.
Power plant: TBD.
Dimensions: TBD.
Weight: TBD.

Space Tracking and Surveillance System (formerly SBIRS Low).

Common name: STSS
In brief: infrared surveillance and tracking satellites to detect and track ballistic missiles from launch to impact. System is sensor component of layered ballistic missile defense system and will work with SBIRS High (see above).
Function: infrared surveillance.
Operator: MDA (acquisition); AFSPC.
First launch: 2007 for R&D, planned.
Constellation: two.
On orbit: none.
Contractor: Northrop Grumman, Raytheon.
Power plant: TBD.
Dimensions: TBD.
Weight: TBD.

Transformational Satellite Communications System

Common name: TSAT
In brief: joint communications satellite being designed to provide Internet-like connectivity to warfighters at the tactical level. It will feature laser crosslink and greatly reduced transmission time to users on the ground. Intended to replace Advanced Extremely High Frequency system (see p. 43), it is slated for launch around 2012.

Currently in design and risk-reduction phase.

Function: EHF communications.
Operator: MILSATCOM JPO (acquisition); AFSPC.
First launch: 2012, planned.
Constellation: five.
On orbit: none.
Orbit altitude: 22,300 miles.
Contractor: TBD.
Power plant: TBD.
Dimensions: TBD.
Weight: TBD.

UHF Follow-On Satellite

Common name: UFO
In brief: new generation satellites providing secure, antijam communications; replaced FLTSATCOM satellites.
Function: UHF and EHF communications.
Operator: Navy.
First launch: March 25, 1993.
Constellation: four primary, four redundant.
On orbit: nine.
Orbit altitude: 22,300 miles.
Contractor: Boeing Satellite Systems.
Power plant: solar array, 2,500-3,800 watts.
Dimensions: 60 ft deployed (F-2-F-7); 86 ft deployed (F-8-F10).
Weight: 2,600-3,400 lb.

Wideband Gap-Filler System

Common name: WGS
In brief: high data rate satellite broadcast system (primarily commercial product) meant to bridge the communications gap between current systems—DSCS and GBS—and AWS (see above).
Function: wideband communications and point-to-point service (Ka-band, Ku-band, X-band frequencies).
Operator: AFSPC.
First launch: 2006, planned.
Constellation: three-five.
Orbit altitude: GEO.
Contractor: Boeing.

Power plant: solar arrays, 9,934 watts.
Dimensions: based on Boeing 702 bus.
Weight: 13,000 lb.

Dark and Spooky

A number of intelligence satellites are operated by US agencies in cooperation with the military. The missions and, especially, the capabilities are closely guarded secrets. Using a page from the Soviet book on naming satellites, the US government started in the 1980s calling all government satellites "USA" with a

sequential number. This allowed them to keep secret the names of satellites which monitor the Earth with radar, optical sensors, and electronic intercept capability.

Most of the names of satellites, such as White Cloud (ocean reconnaissance), Aquacade (electronic ferret), and Trumpet (Sigint), are essentially open secrets but cannot be confirmed by the Intelligence Community. However, the move to declassify space systems has led to the release of selected information on some systems. Pictures of the

Lacrosse radar imaging satellite have been released without details on the system.

Recently, NRO revealed that it is developing a new satellite system, dubbed ORCA for Optical Relay Communications Architecture. ORCA will be a next generation communications satellite with laser and radio frequency communications, providing at least 10 times the capacity of current systems. Specific details, including a launch time frame, currently are classified, but DOD and NRO include ORCA in the Transformational Communications Architecture, as a generation systems.

Major Civilian Satellites in US Military Use

Geostationary Operational Environmental Satellite

Common name: GOES
In brief: in equatorial orbit to collect weather data for short-term forecasting.
Function: storm monitoring and tracking, meteorological research.
Operator: NOAA.
First launch: Oct. 16, 1975 (GOES-1).
Constellation: two, with on-orbit spare.
Orbit altitude: 22,300 miles.
Contractor: Space Systems/Loral.
Power plant: solar array, 1,050 watts.
Dimensions: 6.6 x 6.9 x 7.5 ft; 15.8 x 8.9 ft deployed. (GOES-10).
Weight: 4,600 lb.

Globalstar

Common name: Globalstar
In brief: mobile communications with provision for security controls.
Function: communications.
Operator: Globalstar L.P.
First launch: February 1998.
Constellation: 48.
Orbit altitude: 878 miles.
Contractor: Space Systems/Loral.
Power plant: solar array, 1,100 watts.
Dimensions: 4.9 x 35.3 ft deployed.
Weight: 990 lb.

Ikonos

Common name: Ikonos
In brief: one-meter resolution Earth imaging. Slated for shutdown in 2007.
Function: remote sensing.
Operator: Space Imaging, Inc.
First launch: Sept. 24, 1999.
Constellation: one.
Orbit altitude: 423 miles.
Contractor: Lockheed Martin.
Power plant: solar array.
Dimensions: 5.9 x 5.9 x 5.2 ft.
Weight: 1,600 lb.

Inmarsat

Common name: Inmarsat
In brief: peacetime mobile communications services, primarily by US Navy.
Function: communications.
Operator: International Maritime Satellite Organization.
First launch: February 1982 (first lease), Oct. 30, 1990 (first launch).
Constellation: nine.
Orbit altitude: 22,300 miles.
Contractor: Lockheed Martin (Inmarsat 3).
Power plant: solar array, 2,800 watts.
Dimensions: 6.9 x 5.9 x 57.8 ft deployed.
Weight: 4,545 lb (Inmarsat 3).

Intelsat

Common name: Intelsat
In brief: routine communications and distribution of Armed Forces Radio and TV Services network.
Function: communications.
Operator: International Telecommunications Satellite Organization.
First launch: April 6, 1965 (Early Bird).
Constellation: 20.
Orbit altitude: 22,300 miles.
Contractor: Space Systems/Loral (Intelsat 9 series).
Power plant: solar array, 8,500 watts (Intelsat 902).
Dimensions: 9.2 x 11.55 x 18.5 ft; 102.3 ft deployed (Intelsat 902).
Weight: 10,390 lb (Intelsat 902).

Iridium

Common name: Iridium
In brief: voice, fax, data transmission.
Function: handheld, mobile communications.
Operator: Iridium L.L.C.
First Launch: May 5, 1997.
Constellation: 66 (six on-orbit spares).
Orbit: 485 miles.
Contractor: Lockheed Martin, Motorola.
Power plant: solar array, 590 watts.
Dimensions: 3.3 x 13.5 ft.
Weight: 1,516 lb.

Landsat

Common name: Landsat
In brief: imagery use includes mapping and planning for tactical operations.
Function: remote sensing.
Operator: NASA.
First launch: July 23, 1972.
Constellation: one.
Orbit altitude: 438 miles (polar).
Contractor: Lockheed Martin.
Power plant: solar array, 1,550 watts.
Dimensions: 9 x 14 ft.
Weight: 4,800 lb.

National Polar-orbiting Operational Environmental Satellite System

Common name: NPOESS
In brief: advanced joint civil-military polar environmental satellite that provides weather, atmosphere, ocean, land, and near-space data. Managed by tri-agency (DOD, Department of Commerce, and NASA) integrated program office. Designed to replace USAF's DMSP and NOAA's Polar-orbiting Operational Environmental Satellite (POES) (see below).

Function: worldwide environmental forecasting.

Operator: IPO (AFSPC for acquisition and launch; NOAA for operations).
First launch: 2008, planned.
Constellation: two.
On orbit: none.
Orbit altitude: 22,300 miles.
Contractor: Northrop Grumman.
Power plant: TBD.
Dimensions: TBD.
Weight: TBD.

Orbcomm

Common name: Orbcomm
In brief: potential military use under study in Joint Interoperability Warfighter Program.
Function: mobile communications.
Operator: Orbcomm Global L.P.
First launch: April 1995.
Constellation: 35.
Orbit altitude: 500-1,200 miles.
Contractor: Orbital Sciences.
Power plant: solar array, 160 watts.
Dimensions: 7.3 x 14.2 ft.
Weight: 90 lb.

Pan Am Sat

Common name: Pan Am Sat
In brief: routine communications providing telephone, TV, radio, and data.
Function: communications.
Operator: Pan Am Sat.
First launch: 1983.
Constellation: 21.
Orbit altitude: 22,300 miles.
Contractor: Boeing.
Power plant: solar array, 4,800 watts.
Dimensions: 16.2 x 8.8 x 12 ft; 86 ft deployed (Galaxy III-R).
Weight: 6,760 lbs (Galaxy III-R).

Polar-orbiting Operational Environmental Satellite (also known as NOAA-K, L, and M before launch; NOAA-15, 16, and 17, respectively, once on orbit).

Common name: POES
In brief: two advanced third generation environmental satellites (one morning orbit and one afternoon orbit) provide longer-term weather updates for all areas of the world. Final two spacecraft in this series are NOAA-N (slated for launch in 2005) and N Prime. To be replaced by NPOESS.
Function: extended weather forecasting.
Operator: NOAA (on-orbit); NASA (launch).

First launch: May 13, 1998 (NOAA-15).
Constellation: two.
Orbit altitude: 517 miles.
Contractor: Lockheed Martin.
Power plant: solar array, 1,000+ watts.
Dimensions: 6.2 x 13.8 ft (NOAA-15).
Weight: approx 4,900 lb (NOAA-15).

Quickbird 2

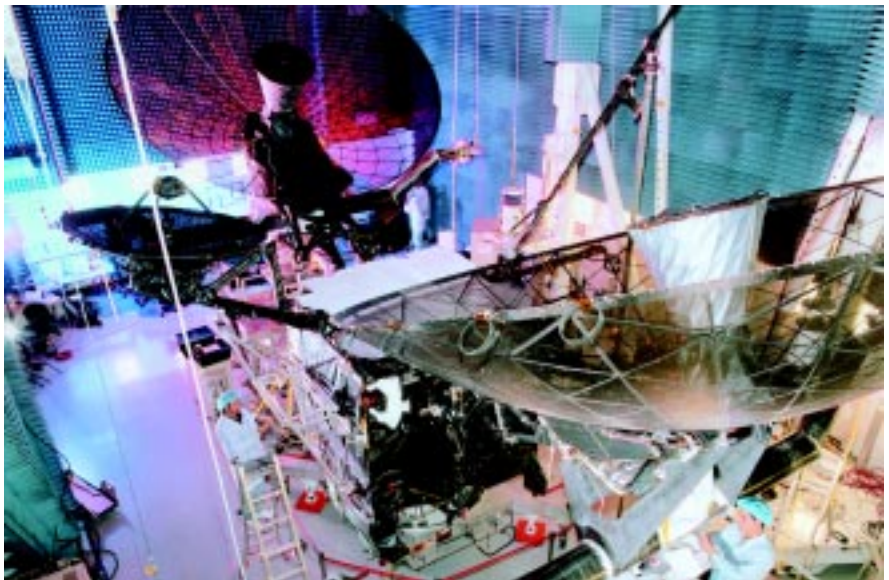
Common name: Quickbird 2
In brief: high-resolution imagery for mapping, military surveillance, weather research, and other uses.
Function: remote sensing.
Operator: DigitalGlobe.
First launch: Oct. 18, 2001.
Constellation: one.
Orbit altitude: 279 miles.
Contractor: Ball Aerospace.
Power plant: solar array.
Dimensions: 9.8 x 5.2 x 5.2 ft.
Weight: 2,088 lb.

Satellite Pour l'Observation de la Terre

Common name: SPOT
In brief: terrain images used for mission-planning systems, terrain analysis, and mapping.
Function: remote sensing.
Operator: SPOT Image S.A. (France).
First launch: Feb. 22, 1986.
Constellation: three.
Orbit altitude: 509 miles.
Contractor: Matra Marconi Space France.
Power plant: solar array, 2,100 watts (SPOT 4).
Dimensions: 6.6 x 6.6 x 18.4 ft (SPOT 4).
Weight: 5,940 lb (SPOT 4).

Telstar

Common name: Telstar
In brief: commercial satellite-based, rooftop-to-rooftop communications for



A Tracking and Data Relay Satellite System spacecraft undergoes factory testing, prior to shipment to Cape Canaveral, Fla.

US Army and other DOD agencies.

Function: communications.
Operator: Loral Skynet.
First launch: November 1994.
Constellation: three.
Orbit altitude: 22,300 miles.
Contractor: Space Systems/Loral.
Power plant: solar array, 7,000 watts.
Dimensions: 28.3 x 18.5 x 102.6 ft deployed (Telstar 12).
Weight: 3,514 lb (Telstar 12).

Tracking and Data Relay Satellite System

Common name: TDRSS
In brief: global network that allows other

spacecraft in LEO to communicate with a control center without an elaborate network of ground stations.

Function: communications relay.
Operator: NASA.
First launch: April 1983.
Constellation: six.
Orbit altitude: 22,300 miles.
Contractor: Boeing.
Power plant: solar array, 2,042 watts (TDRSS H, I, J).
Dimensions: 43.5 x 68.1 ft (H, I, J).
Weight: approx 3,300 lb (H, I, J).

Major US Launchers in US Military Use

Athena I

Function: lift low to medium weights.
First launch: Aug. 22, 1997.
Launch site: CCAFS, VAFB.
Contractor: Lockheed Martin.

Athena II

Function: lift low to medium weights.
First launch: Jan. 6, 1998.
Launch site: CCAFS, VAFB.
Contractor: Lockheed Martin.

Atlas II

Function: lift medium weights.
Variants: IIA and IIAS.
First launch: Dec. 7, 1991.
Launch site: CCAFS, VAFB.
Contractor: Lockheed Martin.

Atlas III

Function: lift medium to heavy weights.
Variants: IIIA and IIIB.
First launch: May 24, 2000 (IIIA).
Launch site: CCAFS, VAFB.
Contractor: Lockheed Martin.

Atlas V

Function: lift medium to heavy weights.
First launch: Aug. 21, 2002.
Launch site: CCAFS, VAFB.
Contractor: Lockheed Martin.

Delta II

Function: lift medium weights.
First launch: Feb. 14, 1989.
Launch site: CCAFS, VAFB.
Contractor: Boeing.

Delta III

Function: lift medium weights.
First launch: Aug. 26, 1998.
Launch site: CCAFS.
Contractor: Boeing.

Delta IV

Function: lift medium to heavy weights.
First launch: Nov. 20, 2002.
Launch site: CCAFS, VAFB.
Contractor: Boeing.

EELV

Function: lift medium to heavy weights.
Note: Atlas V and Delta IV (see individual entries) are participating in USAF's evolved expendable launch vehicle (EELV) modernization program to cut launch costs by 25 to 50 percent. These systems will eventually replace Delta II, Atlas II, Titan II, and Titan IV launch vehicles.

Pegasus

Function: lift low weights.

Variants: Standard and XL.

First launch: (Standard) April 5, 1990; (XL) June 27, 1994.
Launch site: dropped from L-1011 aircraft.
Contractor: Orbital Sciences, Alliant.

Space shuttle

Function: lift heavy weights.
First launch: April 12, 1981.
Launch site: Kennedy Space Center, Fla.
Contractor: Boeing (Launch).

Taurus

Function: lift low weights.
Variants: Standard and XL.
First launch: March 13, 1994.
Launch site: CCAFS, VAFB, Wallops Is.
Contractor: Orbital Sciences.

Titan II

Function: lift low to medium weights.
First launch: April 8, 1964 (NASA).
Launch site: VAFB.
Contractor: Lockheed Martin.

Titan IVB

Function: lift heavy weights.
First launch: (IVB) Feb. 23, 1997.
Launch site: CCAFS, VAFB.
Contractor: Lockheed Martin.

Foreign Space Activities



Foreign Orbital Launches

(As of Dec. 31, 2003)

Year	China	ESA	France	India	Israel	Japan	Russia	UK
1965			1				48	
1966			1				44	
1967			2				66	
1968							74	
1969							70	
1970	1		2			1	81	
1971	1		1			2	83	1
1972						1	74	
1973							86	
1974						1	81	
1975	3		3			2	89	
1976	2					1	99	
1977						2	98	
1978	1					3	88	
1979		1				2	87	
1980				1		2	89	
1981	1	2		1		3	98	
1982	1					1	101	
1983	1	2		1		3	98	
1984	3	4				3	97	
1985	1	3				2	98	
1986	2	2				2	91	
1987	2	2				3	95	
1988	4	7			1	2	90	
1989		7				2	74	
1990	5	5			1	3	75	
1991	1	8				2	59	
1992	4	7		1		1	54	
1993	1	7				1	47	
1994	5	6		2		2	48	
1995	2	11			1	1	32	
1996	3	10		1		1	25	
1997	6	12		1		2	28	
1998	6	11				2	24	
1999	4	10		1			28	
2000	5	12					35	
2001	1	8		2		1	25	
2002	4	11		1	1	3	25	
2003	6	4		2		2	24	
Total	76	152	10	14	4	59	2,628	1

Russian Military vs. Civil Launches

(As of Dec. 31, 2003)

Year	Military	Civilian	Total
1957	0	2	2
1958	0	1	1
1959	0	3	3
1960	0	3	3
1961	0	6	6
1962	5	15	20
1963	7	10	17
1964	15	15	30
1965	25	23	48
1966	27	17	44
1967	46	20	66
1968	49	25	74
1969	51	19	70
1970	55	26	81
1971	60	23	83
1972	53	21	74
1973	58	28	86
1974	52	29	81
1975	60	29	89
1976	74	25	99
1977	69	29	98
1978	60	28	88
1979	60	27	87
1980	64	25	89
1981	59	39	98
1982	68	33	101
1983	58	40	98
1984	63	34	97
1985	64	34	98
1986	63	28	91
1987	62	33	95
1988	53	37	90
1989	42	32	74
1990	45	30	75
1991	30	29	59
1992	32	22	54
1993	26	21	47
1994	26	22	48
1995	15	17	32
1996	8	17	25
1997	10	18	28
1998	9	15	24
1999	6	22	28
2000	7	28	35
2001	9	16	25
2002	7	18	25
2003	7	17	24
Total	1,659	1,051	2,710

Russian Military Launches for 2003

	Launches	Spacecraft
Communications	3	4
Early warning	1	1
Electronic intelligence (ocean recon)	0	0
Navigation	2	4
Photoreconnaissance	1	1
Total	7	10

Russian Operational Military Spacecraft

(As of Dec. 31, 2003)

Mission	Type	Number
Communications	Kosmos (Geizer)	1
	Kosmos (Strela-3)	6
	Molniya-1T	5
	Molniya-3	5
	Raduga/Raduga-1	6
Early warning	Kosmos (Oko)	3
	Kosmos (Prognoz)	1
Electronic intelligence	Kosmos (Tselina-2)	1
Navigation	Kosmos (GLONASS)*	10
	Kosmos (Parus)	6

*Kosmos (GLONASS) is both civilian and military.

Russian Launch Site Activity for 2003

Vehicle	Number of launches
Baikonur Cosmodrome, Tyuratam, Kazakhstan	
Proton-K/Blok DM-2	1
Proton-K/Blok DM-2M	2
Proton-K/Briz-M	2
Soyuz-FG	2
Soyuz-FG/Fregat	2
Soyuz-U	4
Strela 1	1
Total	14
Odyssey Platform, Pacific Ocean (Sea Launch)	
Zenit-3SL	3
Total	3
Plesetsk Cosmodrome, Plesetsk, Russia	
Kosmos-3M	3
Molniya-M	2
Rokot/Briz-KM	2
Total	7

AP photo/Mikhail Metzger



USAF Lt. Col. Edward Fincke (left), a Russian cosmonaut, and a Dutch astronaut arrive for a training session in preparation for a mission on the International Space Station.

Russian Military/Civil Payloads by Mission, 1957-2003

(As of Dec. 31, 2003)

Antisatellite target tests	18
Antisatellite interceptor tests	20
Communications	334
Early warning	83
Earth orbital science	212
Earth resources	100
Electronic intelligence	133
Fractional orbital bombardment system tests	18
General engineering and materials processing	16
Geodesy	34
Navigation	236
Ocean electronic intelligence	85
Photographic reconnaissance	809
Theater communication	535
Undefined military operations	162
Weather	75
Total	2,870

Russian Manned Spaceflights

(As of Dec. 31, 2003)

Year	Flights	Persons*
1961	2	2
1962	2	2
1963	2	2
1964	1	3
1965	1	2
1966	0	0
1967	1	1
1968	1	1
1969	5	11
1970	1	2
1971	2	6
1972	0	0
1973	2	4
1974	3	6
1975	4	8
1976	3	6
1977	3	6
1978	5	10
1979	2	4
1980	6	13
1981	3	6
1982	3	8
1983	2	5
1984	3	9
1985	2	5
1986	1	2
1987	3	8
1988	3	9
1989	1	2
1990	3	7
1991	2	6
1992	2	6
1993	2	5
1994	3	8
1995	2	6
1996	2	5
1997	2	5
1998	2	6
1999	1	3
2000	2	5
2001	2	6
2002	2	6
2003	2	5
Total	96	222

*Total number of persons who flew in space in a given year. Some individuals made multiple flights.



China's first manned spacecraft, Shenzhou 5, lifts off at the Jiuquan Satellite Launch Center on Oct. 15, 2003. China is only the third country to launch a human being into orbit.

Spacefarers (As of Dec. 31, 2003)

Nation	Persons
Afghanistan	1
Austria	1
Belgium	2
Bulgaria	2
Canada	8
China	1
Cuba	1
Czechoslovakia	1
France	9
Germany	9
Hungary	1
India	1
Israel	1
Italy	4
Japan	5
Mexico	1
Mongolia	1
Netherlands	1
Poland	1
Romania	1
Russia	97
Saudi Arabia	1
Slovakia	1
South Africa	1
Spain	1
Switzerland	1
Syria	1
Ukraine	1
United Kingdom	1
United States	274
Vietnam	1
Total	432

Payloads in Orbit (As of Dec. 31, 2003)

Launcher/operator	Objects
Russia	1,368
United States	1,054
Japan	88
Intl. Telecommunications Satellite Orgn.	60
France	56
China	46
ESA	43
United Kingdom	32
India	27
Germany	22
Canada	21
Luxembourg	13
Italy	11
Australia	10
Brazil	10
Saudi Arabia	10
Sweden	10
Indonesia	9
NATO	8
South Korea	8
Argentina	7
Mexico	6
Spain	6
Czechoslovakia	5
Israel	5
Netherlands	5
Turkey	5
International Space Station	4
Thailand	4
Denmark	3
Malaysia	3
Norway	3
Egypt	2
France/Germany	2
Philippines	2
United Arab Emirates	2
Algeria	1
Chile	1
Greece	1
Nigeria	1
Pakistan	1
Portugal	1
Singapore	1
South Africa	1
Taiwan	1
Total	2,979

Military Space Lore



Military Space Firsts

March 22, 1946. First US rocket to leave Earth's atmosphere, JPL-Ordnance WAC, reaches 50-mile height after launch from White Sands Proving Ground, N.M.

Feb. 24, 1949. Bumper-WAC Corporal two-stage rocket, first with fully tanked second stage, reaches record altitude of 244 miles and velocity of 5,150 mph.

July 24, 1950. Bumper No. 8 becomes first missile launched from Cape Canaveral, Fla.

Sept. 20, 1956. US Jupiter C rocket, part of the Army's 1954 Project Orbiter, achieves record first flight, reaching altitude of 682 miles and landing 3,400 miles from Cape Canaveral.

Oct. 4, 1957. USSR launches Sputnik 1, first man-made satellite, into Earth orbit.

Dec. 17, 1957. USAF Atlas ICBM makes first successful test flight.

Jan. 31, 1958. US launches its first satellite, Explorer 1.

Dec. 18, 1958. Project Score spacecraft conducts first US active communication from space.

Feb. 28, 1959. In test, USAF successfully launches Discoverer 1 (of then-classified Corona program), world's first polar-orbiting satellite, from Vandenberg AFB, Calif..

April 6, 1959. The first military unit to be charged with conducting military satellite operations, USAF's 6594th Test Wing, is established at Palo Alto, Calif.

April 13, 1959. Air Force Thor/Agna A boosts into orbit the Discoverer 2 satellite, the first satellite to be stabilized in orbit in all three axes, to be maneuvered on command from Earth, to separate a re-entry vehicle on command, and to send its re-entry vehicle back to Earth.

Aug. 7, 1959. US carries out first satellite intercontinental relay of a voice message.

Aug. 7, 1959. Explorer 6 spacecraft transmits first television pictures from space.

April 1, 1960. TIROS 1 is first US weather satellite to go aloft.

April 13, 1960. Transit 1B becomes first US navigation satellite in space.

May 24, 1960. MIDAS II is first early warning satellite in orbit.



Bumper No. 8 lifts off from Cape Canaveral on July 24, 1950, as members of the media record the event a few hundred feet from the launchpad. Pictured in the lower right corner is the "control center," which was nothing more than a wooden shack.

June 22, 1960. US launches Galactic Radiation and Background (GRAB) satellite, the nation's first successful reconnaissance spacecraft. It collects electronic intelligence (Elint) from Soviet air defense radars.

Aug. 18, 1960. Discoverer/Corona satellite takes first image of Soviet territory ever snapped from space.

Aug. 19, 1960. Capsule containing first satellite photographs of Soviet Union ejected from Discoverer 14 becomes first orbital payload recovered in midair by C-119 Flying Boxcar.

April 12, 1961. Soviet cosmonaut Yuri Gagarin pilots Vostok 1 through nearly one orbit to become first human in space.

May 5, 1961. Lt. Cmdr. Alan B. Shepard Jr., aboard Freedom 7 Mercury capsule, becomes first American in space, climbing to 116.5 miles during suborbital flight lasting 15 minutes, 28 seconds.

July 12, 1961. First Atlas D/Agna B booster lifts MIDAS III satellite, the heaviest US spacecraft to date, into a record 1,850-mile-high orbit.

July 21, 1961. Capt. Virgil I. "Gus" Grissom becomes the first Air Force astronaut in space, reaching an altitude of

118.3 miles on the second Mercury mission.

Feb. 20, 1962. Project Mercury astronaut Lt. Col. John H. Glenn Jr., aboard Friendship 7 capsule, completes first US manned orbital flight.

April 23, 1962. The 6555th Aerospace Test Wing launches an Atlas D/Agna B vehicle that carries NASA's Ranger 4, the first US instrument package to reach the moon.

May 23 1962. US deploys first DMSP spacecraft.

July 17, 1962. Air Force Capt. Robert M. White earns astronaut wings when he reaches altitude of nearly 60 miles in rocket-powered X-15, first aircraft to be flown to lower edge of space, considered to be 50 miles.

May 15, 1963. USAF Maj. L. Gordon Cooper Jr. makes nearly 22 orbits in spacecraft Faith 7, becoming the first American astronaut to spend a complete day in orbit, first to perform an entirely manual re-entry, and last to go into space alone.

Oct. 17, 1963. Vela Hotel satellite performs first space-based detection of nuclear explosion.

Aug. 14, 1964. First Atlas/Agena D standard launch vehicle successfully fired from Vandenberg.

March 18, 1965. First space walk conducted by Alexei Leonov from Soviet Voskhod 2.

June 4, 1965. Gemini 4 astronaut USAF Maj. Edward H. White II performs first American space walk.

June 18, 1965. USAF accepts Titan III, first Air Force vehicle specifically designed and developed as a military space booster.

Dec. 15, 1965. In a first for the US space program, crews of Gemini 6 and Gemini 7 rendezvous in space. Navy Capt. Walter M. Schirra and USAF Maj. Thomas P. Stafford in Gemini 6 maneuver to within a foot of Gemini 7.

Dec. 16, 1965. Astronauts Schirra and Stafford conduct the first controlled re-entry of a manned spacecraft to a predetermined landing point on Earth.

Jan. 25, 1967. Soviet Kosmos 139 antisatellite weapon carries out first fractional orbital bombardment system test.

Jan. 27, 1967. First deaths in US spacecraft occur in flash fire in Apollo 1 command module, killing astronauts Lt. Cmdr. Roger B. Chaffee and USAF Lt. Col. Virgil I. Grissom and Edward H. White II.

July 3-4, 1967. Air Force, Army, and Navy conduct first satellite-based tactical communications.

Oct. 20, 1968. Soviet Kosmos 248 and Kosmos 249 spacecraft carry out first co-orbital antisatellite test.

Dec. 21-27, 1968. Apollo 8 astronauts—USAF Col. Frank Borman, Navy Cmdr. James A. Lovell Jr., and USAF Maj. William A. Anders—become the first humans to orbit the moon.

July 20, 1969. At 10:56 p.m. EDT, Apollo 11 astronaut Neil A. Armstrong puts his foot on the surface of the moon, becoming the first human to do so. He and lunar module pilot, USAF Col. Edwin E. "Buzz" Aldrin Jr., spend just under three hours walking on the moon, while the command module pilot, USAF Lt. Col. Michael Collins, orbits overhead.

November 1970. USAF launches first classified DSP satellite, whose infrared sensors provide space-based early warning of missile launches.

April 19, 1971. First space station, Salyut 1, goes aloft.

Nov. 2, 1971. Titan IIIC launches first DSCS Phase II satellites into GEO.

Feb. 9, 1978. Atlas booster launched at Cape Canaveral carries Navy's first Fleet communications satellite, dubbed FLTSATCOM, into orbit.

Feb. 22, 1978. Atlas booster carries first GPS Block I satellite into orbit.

Dec. 13, 1978. Successful launch of two DSCS II satellites puts full four-satellite constellation at users' disposal for first time.

April 12-14, 1981. First orbital flight of space shuttle and first landing from orbit of reusable spacecraft.

Dec. 20, 1982. First DMSP Block 5D-2 satellite launched.

May 1, 1983. USAF enlisted satellite control specialists officially begin operations at Air Force Space Command, marking the first time in its history that noncommissioned Air Force personnel have been permitted to "fly" spacecraft on a regular basis.

Aug. 30, 1983. USAF Col. Guion S. Bluford Jr. becomes the first African American in space, as a mission specialist aboard *Challenger*.

Jan. 24-27, 1985. On the 15th shuttle mission, the crew of *Discovery* carries out the first dedicated DOD flight, deploying a classified payload, believed to be a signals intelligence (Sigint) satellite.

Sept. 13, 1985. First US antisatellite intercept test destroys Solwind scientific satellite by air-launched weapon.

Oct. 3, 1985. Shuttle *Atlantis* performs first launch of pair of DSCS III satellites from space shuttle using inertial upper stage (IUS).

Jan. 28, 1986. Space shuttle *Challenger* explodes after liftoff, killing seven astronauts.

Feb. 14, 1989. Launch of first Block II GPS satellite begins operational constellation.

June 14, 1989. First Titan IV heavy-lift space booster is successfully launched from Launch Complex 40 at Cape Canaveral. The booster, nearly 20 stories tall, carries a classified military payload.

April 24, 1990. Marine Col. Charles F. Bolden becomes the first African American to pilot a US spacecraft, shuttle *Discovery*. He would later be the first African American commander of a shuttle mission, aboard *Discovery* on Feb. 3, 1994.

Aug. 5, 1990. Over Edwards AFB, Calif., a B-52 carrier aircraft drops an air-launched Pegasus space booster on its first flight, which is a success.

Jan. 17, 1991. What USAF calls "the first space war," Operation Desert Storm, opens with air attacks.

Feb. 11, 1992. First military launch of an Atlas II/Centaur takes place at Cape Canaveral.

Jan. 13, 1993. USAF Maj. Susan J. Helms, flying aboard *Endeavour*, becomes first US military woman in space.

July 19, 1993. Launch of DSCS Phase III satellite into GEO provides first full five-satellite DSCS III constellation.

Feb. 7, 1994. First Titan IV Centaur booster launches first Milstar Block I satellite into orbit.

March 13, 1994. First launch of Taurus booster places two military satellites in orbit.

Feb. 6, 1995. USAF Lt. Col. Eileen M. Collins is the first woman to pilot an American spacecraft, doing so when shuttle *Discovery* and space station *Mir* perform the first US-Russian space



Astronaut and USAF Maj. Edward White II became the first American to walk in space during the Gemini 4 mission on June 4, 1965. White was attached to the spacecraft by a 25-foot umbilical line and a 23-foot tether line, both wrapped in gold tape to form one cord.

rendezvous in 20 years. She later would be the first woman to command a shuttle mission, aboard *Columbia* on July 23, 1999.

Feb. 23, 1997. The first Titan IVB launch vehicle lifts off from Launch Complex 40 at Cape Canaveral using an IUS. It launches a DSP satellite.

May 29, 1998. First transfer of an operational military space system to civilian agency occurs when Air Force

hands over primary control of the DMSP on-orbit assets to NOAA.

Nov. 1, 2000. For the first time, a single Delta II rocket, lifting off from Vandenberg, launches two different primary payloads.

Jan. 22-26, 2001. AFSPC's Space Warfare Center conducts Schriever 2001, the first wargame to explore requirements for space control, counters to enemy space capabilities, and the ability of an

enemy to deny the US and its allies the use of space assets.

March 10, 2003. Delta IV boosts into orbit a DSCS III satellite, marking the first launch of a military payload aboard an EELV.

April 22, 2003. AFSPC's 14th Air Force activates first-of-its-kind space intelligence squadron, the 614th SIS, whose mission is to identify and devise means to respond to threats to US space systems.

Space Terms

Aerospace. A physical region made up of Earth's atmosphere and the space beyond.

Aerospace plane. A reusable spacecraft able to operate effectively in both the atmosphere and space. Also known as a "transatmospheric vehicle" or, more currently, "spaceplane."

Apogee. The point of greatest distance from Earth (or the moon, a planet, etc.) achieved by a body in elliptical orbit. Usually expressed as distance from Earth's surface.

Atmosphere. Earth's enveloping sphere of air.

Boost phase. Powered flight of a ballistic missile—i.e., before the rocket burns out.

Burn. The process in which rocket engines consume fuel or other propellant.

Circumterrestrial space. "Inner space" or the atmospheric region that extends from 60 miles to about 50,000 miles from Earth's surface.

Constellation. A formation of satellites orbiting for a specific combined purpose.

Deep space. All space beyond the Earth-moon system, or from about 480,000 miles altitude outward.

Eccentric orbit. An extremely elongated elliptical orbit.

Ecliptic plane. The plane defined by the circle on the celestial sphere traced by the path of the sun.

Elliptical orbit. Any noncircular, closed spaceflight path.

Exosphere. The upper limits of Earth's atmosphere, ranging from about 300 miles altitude to about 2,000 miles altitude.

Expendable Launch Vehicle (ELV). A launch vehicle that cannot be reused after one flight.

Ferret. A satellite whose primary function is to gather electronic intelligence, such as microwave, radar, radio, and voice emissions.

Geostationary Earth orbit. A geosynchronous orbit with 0° inclination in which the spacecraft circles Earth 22,300 miles above the equator and appears from Earth to be standing still.

Geosynchronous Earth orbit (GEO). An orbit at 22,300 miles that is synchronized with Earth's rotation. If a satellite in GEO is not at 0° inclination, its ground path describes a figure eight as it travels around Earth.

Geosynchronous transfer orbit (GTO). An orbit that originates with the parking orbit and then reaches apogee at the GEO.

Ground track. An imaginary line on Earth's surface that traces the course of another imaginary line between Earth's center and an orbiting satellite.

High Earth orbit (HEO). Flight path above geosynchronous altitude (22,300 to 60,000 miles from Earth's surface).

High-resolution imagery. Detailed representations of actual objects that satellites produce electronically or optically on displays, film, or other visual devices.

Inertial upper stage (IUS). A two-stage solid-rocket motor used to propel heavy satellites into mission orbit.

Ionosphere. A region of electrically charged thin air layers that begins about 30 miles above Earth's atmosphere.

Low Earth orbit (LEO). Flight path between Earth's atmosphere and the bottom of the Van Allen belts, i.e., from about 60 to 300 miles altitude.

Magnetosphere. A region dominated by Earth's magnetic field, which traps charged particles, including those in the Van Allen belts. It begins in the upper atmosphere, where it overlaps the ionosphere, and extends several thousand miles farther into space.

Medium Earth orbit (MEO). Flight path between LEO, which ends at about 300 miles altitude, and GEO, which is at an average altitude of 22,300 miles.

Mesosphere. A region of the atmosphere about 30 to 50 miles above Earth's surface.

Orbital decay. A condition in which spacecraft lose orbital altitude and orbital energy because of aerodynamic drag and other physical forces.

Orbital inclination. Angle of flight path in space relative to the equator of a planetary body. Equatorial paths are 0° for flights headed east, 180° for those headed west.

Outer space. Space that extends from about 50,000 miles above Earth's surface to a distance of about 480,000 miles.

Parking orbit. Flight path in which spacecraft go into LEO, circle the globe in a waiting posture, and then transfer payload to a final, higher orbit.

Payload. Any spacecraft's crew or cargo; the mission element supported by the spacecraft.

Perigee. The point of minimum altitude above Earth (or the Moon, a planet, etc.) maintained by a body in elliptical orbit.

Period. The amount of time a spacecraft requires to go through one complete orbit.

Polar orbit. Earth orbit with a 90° inclination. Spacecraft on this path could pass over every spot on Earth as Earth rotates under the satellite's orbit (see orbital inclination).

Remote imaging. Images of Earth generated from a spacecraft that provide data for mapping, construction, agriculture, oil and gas exploration, news media services, and the like.

Reusable launch vehicle (RLV). A launch vehicle that can be reused after flight.

Rocket. An aerospace vehicle that carries its own fuel and oxidizer and can operate outside Earth's atmosphere.

Semisynchronous orbit. An orbit set at an altitude of 12,834 miles. Satellites in this orbit revolve around Earth in exactly 12 hours.

Single-stage-to-orbit (SSTO) system. A reusable single-stage rocket that can take off and land repeatedly and is able to boost payloads into orbit.

Stratosphere. That section of atmosphere about 10 to 30 miles above Earth's surface.

Sun synchronous orbit. An orbit inclined about 98° to the equator and at LEO altitude. At this inclination and altitude, a satellite's orbital plane always

maintains the same relative orientation to the sun.

Thermosphere. The thin atmosphere about 50 to 300 miles above Earth's surface. It experiences dramatically increased levels of heat compared to the lower layers.

Transfer. Any maneuver that changes a spacecraft orbit.

Transponder. A radar or radio set that,

upon receiving a designated signal, emits a radio signal of its own.

Troposphere. The region of the atmosphere from Earth's surface to about 10 miles above the equator and five miles above the poles. This is where most clouds, wind, rain, and other weather occurs.

Van Allen belts. Zones of intense radiation trapped in Earth's magnetosphere that could damage unshielded spacecraft.

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